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By
ALMON H. FULLER

BULLETIN 63

Preliminary Report to
UNITED STATES BUREAU OF PUBLIC ROADS
IOWA STATE HIGHWAY COMMISSION
IOWA ENGINEERING EXPERIMENT STATION

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AMES, IOWA

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The purpose of the Engineering Experiment Station is to afford a service, through scientific investigation, evolution of new devices and methods, and tests and analyses of materials:

For the manufacturing and other engineering population and industries of Iowa;

For the industries related to agriculture, in the solution of their engineering problems;

For all people of the state in the solution of the engineering problems of urban and rural life.

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PREFACE

This bulletin is published with the consent of the United States Bureau of Public Roads and the Iowa State Highway Commission, cooperating parties with the Iowa Engineering Experiment Station, as a progress report of the 1922 impact studies, conducted on the Skunk River Bridge on the Lincoln Highway near Ames, Iowa.

The data herein given is to be considered, not as a piece of finished work, but as a mere beginning of the study. It is published at this time with the purpose of making available for general use the results of the progress to date and to invite such discussion as may serve as a guide in conducting future investigations.

PRELIMINARY IMPACT STUDIES—SKUNK RIVER BRIDGE ON THE LINCOLN HIGHWAY NEAR AMES, IOWA

Introduction. The work was undertaken as a cooperative project of the United States Bureau of Public Roads, the Iowa State Highway Commission and the Engineering Experiment Station of Iowa State College.

The structure selected was the Skunk River bridge on the Lincoln Highway one mile east of Ames, Iowa, a 150-foot span, 20-foot roadway, through riveted steel highway bridge with a 6-inch concrete floor on steel stringers. An elevation of the bridge is shown in Fig. 1.

Although the object was primarily to investigate the effect of impact of trucks and tractors upon the particular structure, two related problems naturally presented themselves: first, the distribution of stress throughout various members and portions of members and, second, the comparison of a number of different instruments and an endeavor to determine which ones would be the most suitable for future work..

Organization. The Bureau of Public Roads furnished the services of J. W. Hewes and Frank Kerekes throughout the season and E. B. Smith, senior testing engineer, for a few days in September during which time the new photographic mirror extensometer was used in checking against the instruments which were used during the working season.

The Highway Commission was represented by A. H. Fuller, consulting bridge engineer, who was in general charge and by Herbert Schmidt and R. J. De La Hunt (each about half time) as observers. The Commission also furnished the services of E. C. Tripp and other truck drivers, all of the loads, staging and nearly all of the supplies.

The Experiment Station furnished the services of R. A. Caughey, who was in direct charge of field and office work, and of L. W. Bartow and W. H. E. Dunham as observers.

Much of the work was necessarily of a pioneer nature and required patience, as well as ability and good judgment. These qualities were much in evidence and without them the work would have been of little value. An appreciation is hereby given all the regular force, particularly Professor Caughey who has given much time to the interpreting of the data since the close of the season.

Loads. Two trucks and a caterpillar tractor were used as loads. Their dimensions and concentrations are shown in Fig. 1. Load A, consisting of a load of gravel on a 3½-ton Liberty truck, provided a total load of nearly 15 tons with about 12 tons on the rear axle. Load B, another 3½-ton Liberty truck was loaded with kegs of nails and anvils to a total of about 11 tons with a little over 8 tons on the rear axle. Load C was a 10-ton Holt caterpillar tractor.

In investigating the floor system loads A and C were used separately and A and B together. For the trusses the loads were A and B together and a train consisting of C pulling B and A.

The maximum speed of A and B was about 13 miles an hour and C about 5 miles an hour whether alone or with the train.

Instruments. 1. Four direct reading West extensometers with 20-inch gage. Loaned by department of civil engineering, Iowa State College.

2. One Turneaure recording extensometer with gage from 48 to 54-inch. Loaned by Dean F. E. Turneaure of University of Wisconsin.

3. Eight stremmatographs (recording on smoked glass disks) with 20-inch gage. Loaned by Prof. A. N. Talbot of University of Illinois.

4. One Bureau of Public Roads photographic mirror extensometer with 14-inch gage. Brought out and used by E. B. Smith of Bureau of Public Roads September 18 to 22.

5. One "max" compression instrument of Bureau of Public Roads with 10-inch gage. Brought out and used in laboratory only by E. B. Smith, Bureau Public Roads, September 18 to 22.

6. Two "max" compression instruments loaned by Prof. C. T. Morris of Ohio State University; gage about 24-inch. (Used a few days only at end of season in field and laboratory.)

7. One combination instrument arranged by using the stremmatograph smoked glass disks on the frame of a West extensometer. 20-inch gage.

8. One West strain gage 20-inch gage for checking distribution of stress in stringers, floor beam and hip vertical. Loaned by A. H. Fuller.

9. One Berry strain gage, 20-inch gage used as in 8. Loaned by department of civil engineering, Iowa State College.

Space will not be taken for extended description of the instruments. The Turneaure extensometer, which has been used so extensively for impact in railway bridges is described in transactions of the Am. Soc. C. E. Vol. XLI (1899) p. 412, and in proceedings of the Am. Ry. Eng. Assoc., Vol. 12 (1911), Part 3, pp. 185-202. The stremmatographs developed for measuring the stress in railroad rails by the special committee of this society to report on stresses in railroad track are described in transactions Am. Soc. C. E. Vol. LXXXII (1918), p. 1224.

The West extensometer consists of two yokes about 20 inches apart held together by a constant distance bar connected (with the necessary freedom of motion) to the center of each yoke. A forked end of each yoke is fastened to the bridge member by means of two hardened screws. The movement, due to the deformation of the member, is transmitted to the other ends of the yokes where it is read directly by means of a Last Word Dial. This instrument was developed in the instrument shop of the department of civil engineering at Lafayette College by M. L. West, mechanician, under the direction of the author.

A general idea of all the instruments and manner of attachment are given in Figs. 5 to 8.

Field and office work. The greater part of the field work was done during the months of July and August, 1922. The office work necessary to keep the notes worked up was cared for, usually, by keeping the force inside for a day or two after two or three days in the field.

Observations were taken for four different conditions of the load:—first, at rest for basic static readings; second, runs for various speeds on the clean floor; third, runs for speeds up to the maximum (about 13 miles an hour) over a 1-inch obstruction (usually 1x2-inch cast iron); fourth, runs up to about half speed over a 2-inch obstruction (usually a timber, 2x4-inch.) All of these runs in each series were made with the same setting of instruments.

Results. As it has been impossible to work up all of the data into final form with the available force and impractical to do it inside of several months with any force that could be expected, a few of the most outstanding and significant results have been gathered together and analyzed in a preliminary way so as to give an early indication of the trend of the summer's work.

In a preliminary report presented to the three cooperating interests were given individual readings of about 400 of the 2,500 runs comprising the season's work. These have been condensed to about 200 runs for this bulletin and are given in Tables I to VIII. Averages are made for the static loads and for speed runs under various conditions. The results show many inconsistancies. These are due to a number of causes, such as condition of the tires, position of the trucks, irregularities of the floor surface, the position of obstructions in addition to errors of observation, vibration and inertia of the instruments, etc. On the other hand certain characteristics are so persistent that the interpretation of results becomes a matter of determining the degree of precision rather than the general indication.

Comparison of instruments. The West extensometers and the strematographs were calibrated in standard testing machines on a steel bar in tension for relation between actual unit stresses and the reading of the instruments, and on the vibrating apparatus of the Bureau of Public Roads for inertia and vibration. The West instruments showed a remarkably satisfactory behavior in each respect and apparently assures results which have a precision up to that with which the needle of the dial can be easily read.

The stremmatograph also gives evidence of being reliable, when working normally, but to a much lesser degree of precision. The time required for adjusting the disks in the field and reading them in the office would apparently produce fewer data with less precision (particularly for the lower stresses) than the same time devoted to either the West or the Turneaure extensometers.

No suitable testing machines, or other apparatus were available for calibrating the Turneaure extensometer in direct tension or for inertia or vibration. It was calibrated, in connection with all the

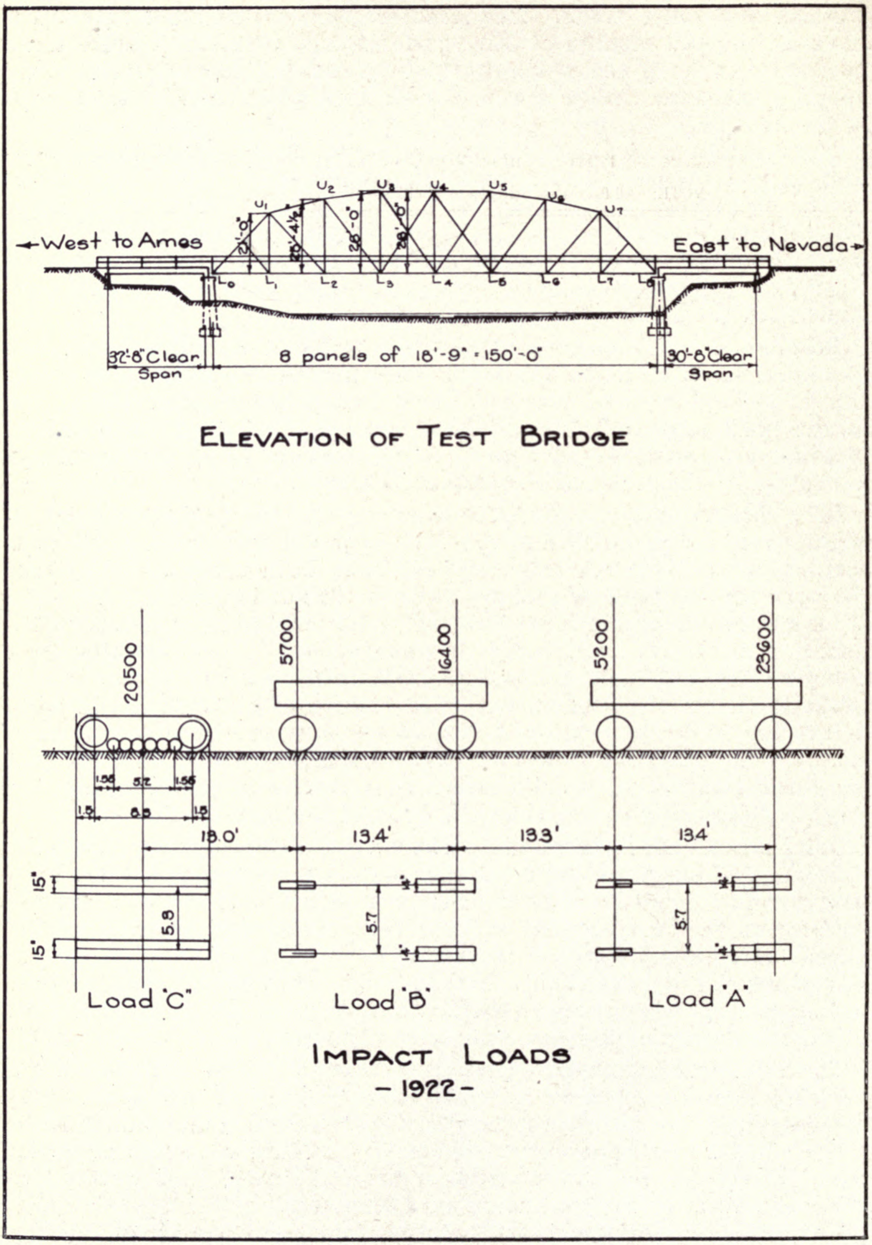

Fig. 1—Elevation of Skunk River bridge and diagrams of impact loads used, showing concentrations.

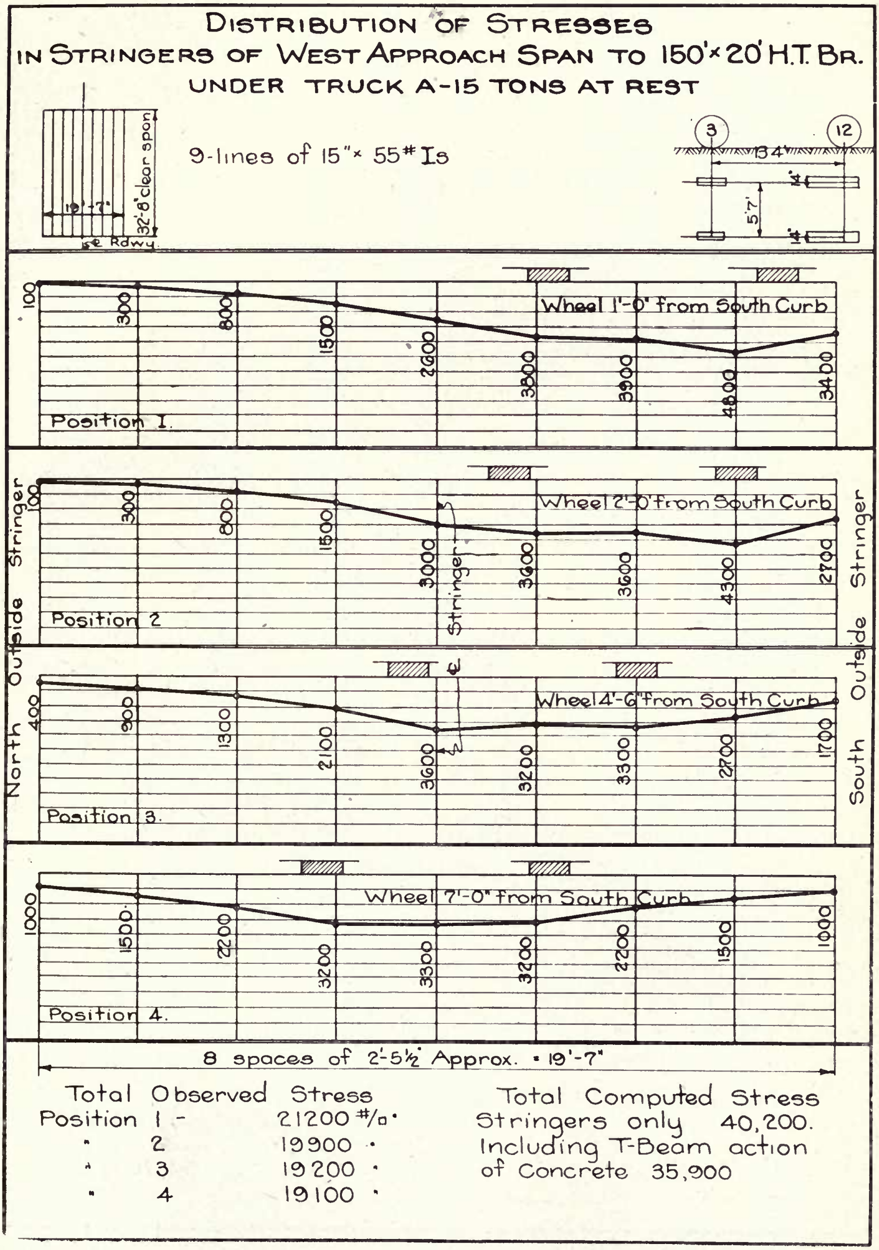

Fig. 2—Stress distribution diagram for stringers of west approach Span. Truck A at rest.

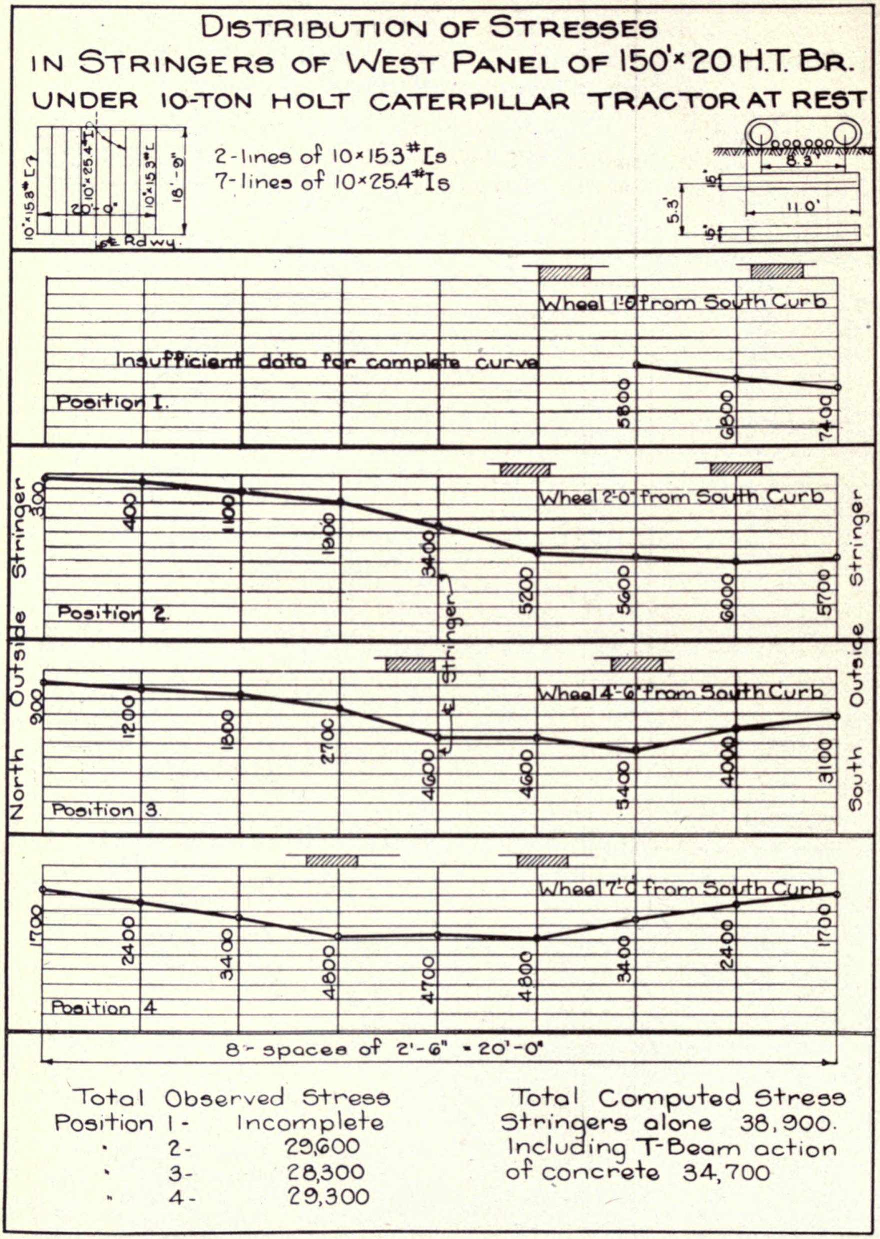

Fig. 3—Stress distribution diagram for stringers of west panel. 10-ton Holt caterpillar tractor at rest.

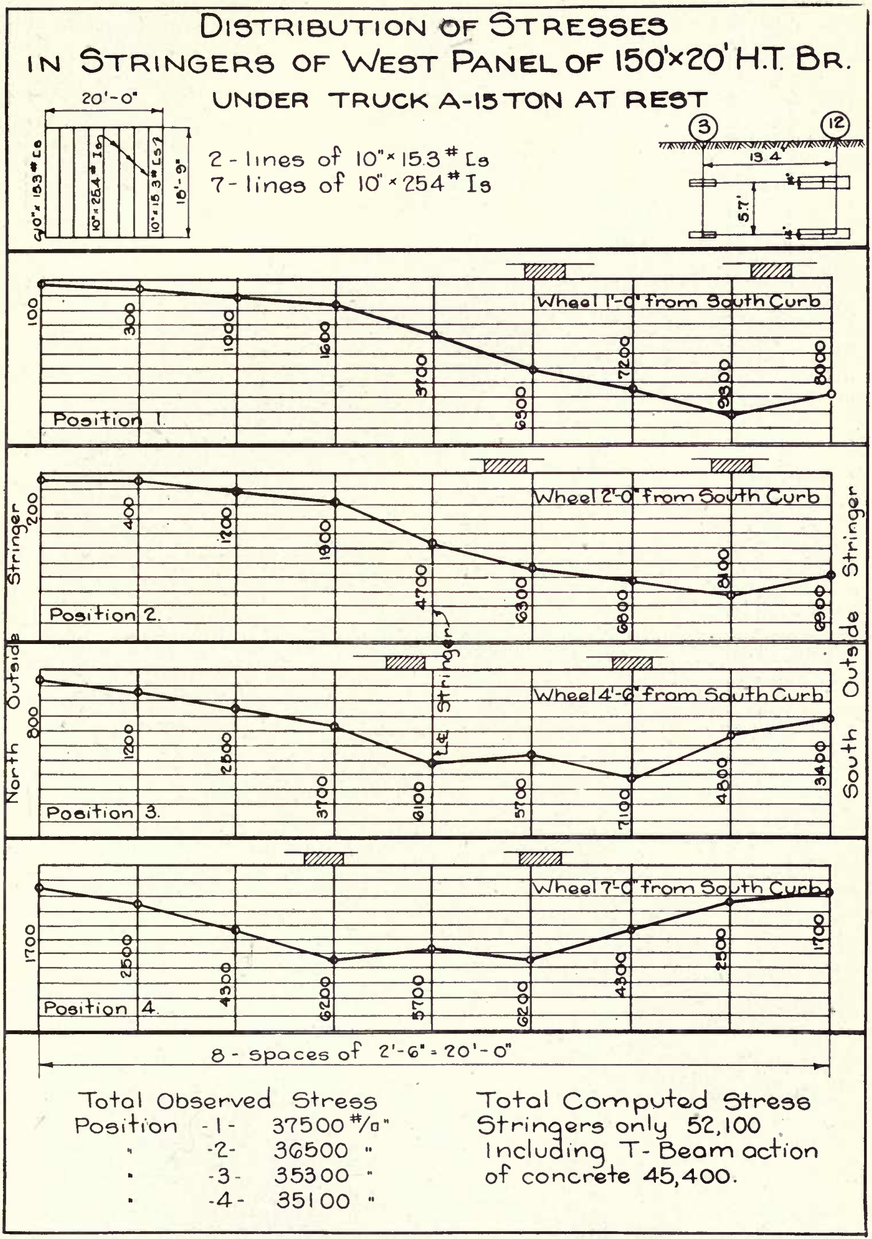

Fig. 4—Stress distribution diagram for stringers of west panel. Truck A at rest.

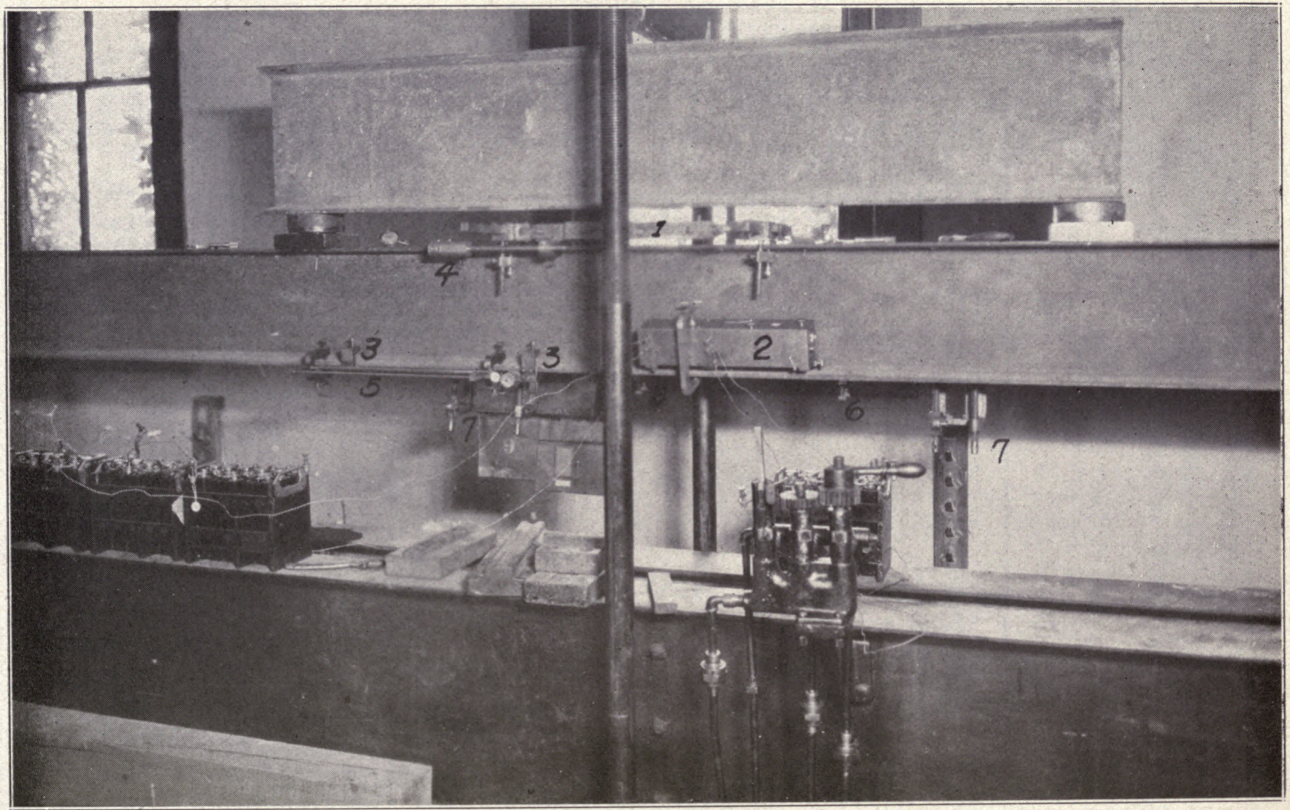

Fig. 5—Laboratory comparison and calibration of various instruments used. 1, Morris "max." 2, Bureau of Public Roads photographic mirror extensometer. 3, stremmatograph. 4, Bureau of Public Roads "max." 5 and 6, West extensometers. Turneaure recording extensometer.

other ones, on the tension flange of an I-beam in flexure. As all of the readings were dependent upon the initial tension in the connecting rod which was not constant, the calibrations have not yet been carried far enough to insure confidence in the precision of the results. Still it seems apparent that this instrument has added materially to the confidence which may be placed on the season's work as a whole. It has furnished significant data for high impacts resulting from the blows of the truck wheels in passing over obstructions. This is particularly helpful where it was impossible to read the dial on the West instruments as illustrated in Table II for runs 1798 to 1602 on stringers.

The fact that the dial could not be read indicates a much higher impact than in the preceeding runs where it could be read. The Turneaure not only gives the same indication but suggests a value. It will be noticed that the impact percentages are usually in closer accord than the unit stresses and, as impact is the factor most needed, the matter of calibration under static stress loses some of its apparent importance.

The continuous vibration produced by the caterpillar tractor was reflected in the erratic behavior of the instruments of which the West seemed to be the most affected. Calibration has not yet been carried far enough to secure a satisfactory interpretation except that this vibration seems more or less distinct from the inertia due to single blows and of greater effect at times and that many of the suggested impacts are doubtless too high.

Results—Stresses and impact. The average impact percentages from Tables I to VIII have been tabulated in Tables IX, X and XI after using some liberty in combining the results of two or more instruments on the same member. These are recorded first by instruments and from these values a figure has been suggested as a probable impact percentage for the member and the loading.

The basis for the interpretation of these impacts will be illustrated by a few references. In Table I for the second stringer, truck B was at rest and A moving; while in Table II both were moving. The apparent inconsistencies between the two sets of runs where the impact is more for the 1-inch obstruction and less for the 2-inch when both trucks are moving may be due to the possibility that in the first instance the maximum effects of both trucks were simultaneous, and in the second were timed so as to conteract each other. The brackets in Table IX indicate impacts beyond the practicability of reading the dial of the West instruments as indicated in Tables I and II, and thus serve to substantiate the high impacts of the Turneaure. For the floor beams with both trucks, Table III, there is a marked contrast between the readings of the West and the stremmatograph for the clean floor and the 1-inch obstruction and a close check for the 2-inch obstruction. The results of the West are given greater weight for the first two conditions because of general dependence for the lower

impacts and the fact that the impact indicated by the stremmatograph for the clean floor is far greater than any other checked result for the floor without obstruction.

For the hip vertical, U1 L1, (Table IV) the West and the Turneaure check nicely for the clean floor but only the Turneaure yields readable results when obstructions are placed. Both instruments however indicate very high impacts for this member, a result which was also apparent in a few observations made in 1921.

In the west approach span there is a remarkable coincidence between the West and the Turneaure instruments on the second stringer

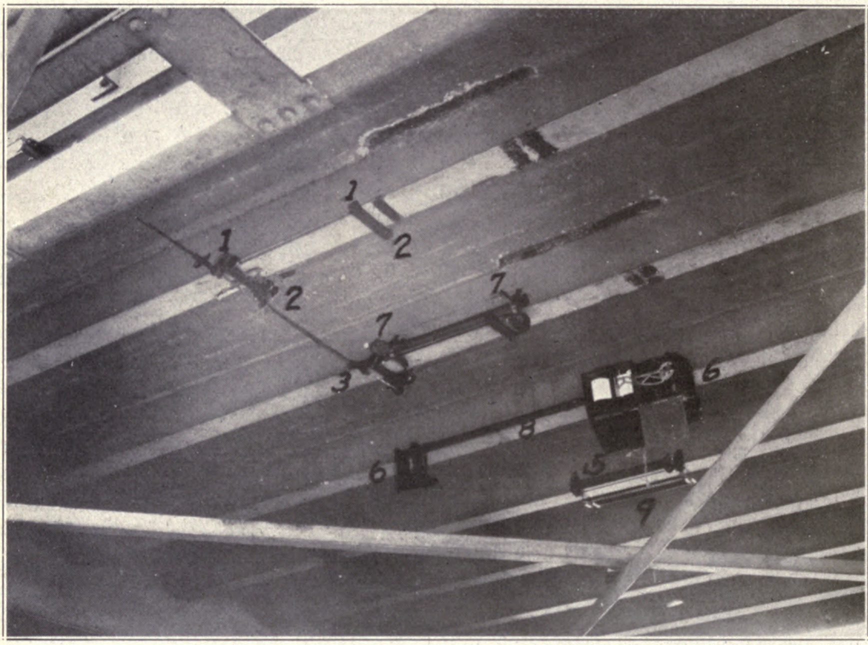

Fig. 6—Set-up of several instruments on the bottom flanges of stringers. 1, 2, 3, 4, and 5, stremmatographs. 6, Turneaure extensometer. 7, 8, and 9, West extensometers.

(Table VII) and large discrepancy between the West and the stremmatograph on the first or outside one (Table VIII) especially for the 1-inch obstruction. The general tendency to give the greater weight to the West is counterbalanced by the fact that it is an unusually high reading and therefore does not inspire the same degree of confidence as do the lower ones. Therefore an average figure is used.

The "probable percentages" of impact, previously referred to, have been taken from the pages just under discussion and tabulated in Table XII after again taking liberty in combining various results for the same class of members and for the two different obstructions.

In admitting that these values have been selected by judgment, based upon observation, rather than by true averages it is pointed out that some of the original data have been given and that anyone interested may draw his own conclusions.

The condensed results will be discussed separately for clean floor and for obstructions. For the clean floor there is no indication of impact above 15 per cent for the floor system and hip verticals of the main span. The suggestion of higher impact for the truss members and for the stringers of the approach span may be due to the cumulative effect as the load travels a greater distance. The high values for reverse

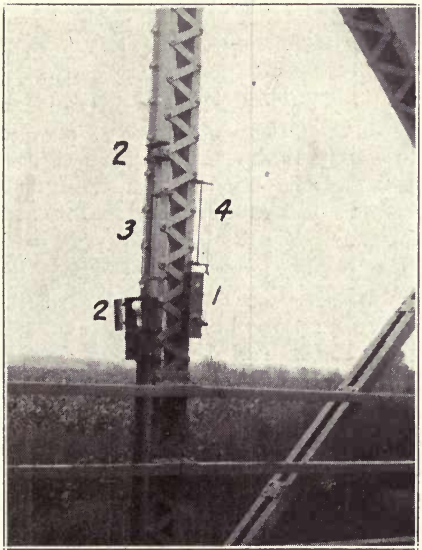

Fig. 7—Instruments on hip vertical, U1 L1. South truss, West end. 1, Bureau Public Roads photographic extensometer. 2, Turneaure extensometer. 3 and 4, West extensometers.

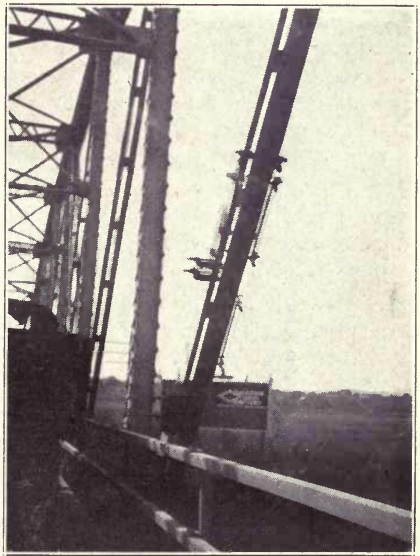

Fig. 8—Instruments on diagonal, L6 U7. North truss, east end. One Turneaure extensometer, two stremmatographs and three West extensometers.

stresses in web members (see Tables V and VI) are based upon fewer data than most of the other results and need further verification. They are sufficiently persistent, however, to warrant careful investigation at a future time.

It may be well to call attention to the fact that full speed (about 13 miles an hour) was used for 1-inch obstructions but that it was thought prudent to keep the speed to about half that amount when the 2-inch obstruction was used. The impacts were somewhere near the same for the two cases. There are many indications above 50 per cent and several above 100 per cent.

The foregoing discussion has been based upon percentages of impact which are averages of all runs for each condition. As a matter of interest an average of the two highest stresses has been added in each instance. When the two averages differ to any great extent the higher indications are probably from an unusual combination of conditions which sometimes occur. These should be recognized and provided for but possibly not by the usual unit stresses.

Too great reliance should not be placed on high individual results recorded on such members as stringers and hip-verticals which receive a very direct effect from sudden blows, such as used in these experiments. Difficulties due to inertia effects in the instruments and in securing reliable readings under such conditions, make the problem a very difficult one and the values here recorded should be considered in the light of these facts. The use of the mirror extensometer of the Bureau of Public Roads in future experiments promises to throw much light on this particular phase of the problem.

It seems evident that the percentage of impact on a highway bridge is likely to be small when the floor is clean and the tire in good condition but that a considerable impact is apt to occur with defective solid tires, chains, blocks of wood, small pieces of rock and other obstructions which may be encountered.

More study and mature judgment are necessary in determining the impact which should be provided for within the usual unit stresses and also for the higher unit stresses which may be allowed for the high impacts which are likely to occur under certain conditions but at long intervals.

Results—Distribution of stresses. (Stringers). Figs. 2, 3 and 4 show the distribution of observed static stress due to loads A and C among the stringers of the main span and due to load A on the stringers of the approach span. As a means of comparison of the total stresses for the various positions of the loads among themselves and with computed stresses, the sums of observed stresses are given, for each position, and compared with the total stresses which would be indicated by the usual methods of computation. To the computed unit stresses under the usual assumption that the steel stringers carry all of the load as simple beams have been added the computed unit stresses under an imperfect T-beam action. These computations were ingeneously made, by Prof. R. A. Caughey, after the neutral axis had been located by strain gage readings under the assumption that the compression in the concrete floor plus the compression in the steel stringers would equal the tension in the stringers. Sufficient data have not been secured to determine to what extent the differences between observed and computed stresses may be due to partial continuity of the stringers.

An analysis of the results show, for the stringers of the main span, that when the live load is placed at the center of the roadway the greatest stress in one stringer equals about one-eighth of the total com-

puted stress and about one-sixth of the total observed stress; and that when the load is placed near one side that the stringer nearest the outside one is stressed about one-fifth of the total stresses as indicated by computations and about one-fourth of those shown by the measurements.

The outside stringers are channels of somewhat more than half the strength and stiffness of the intermediate I-beams. The observations bring out the inadequacy of these outside stringers to give the necessary support to the second stringer and suggests that, in order to keep the stresses and the deflection of the outside two stringers within the range of the intermediate ones, more material perhaps, rather than less, should be placed in the outside ones.

It might be well to state that the stresses given for stringer distribution were not taken altogether from the runs which have been included in this report but also from some special ones which were made for the purpose.

No stress distribution readings were taken on the stringers when two trucks were on the panel. The stresses due to two trucks, parallel, may be anticipated by adding the stresses in each stringer due to one load separately on each side of the roadway. Additions have been made for the two different loads on the main span and for the one load on the approach span. In each case these figures approach, but do not exceed, for the five center stringers, 25 per cent of the observed stress due to the entire load. Under truck A the second stringer (the one next to the outside channel) of the main span would evidently carry between 25 per cent and 30 per cent of one entire truck, but as suggested above, this is a situation which could be relieved in design. On the approach span where the outside stringer is the same size as the others the maximum load on the second stringer, with two loads on the span, appears to be just about one-fourth of one load.

In addition to the distribution of load among the different stringers there is a distribution between the flanges of each stringer which may be uniform or quite irregular depending upon the position of the wheel (which was not always known within a few inches) and other causes. The apparent results are influenced by instrumental variations as well as the actual distribution.

Results—Distribution of stresses. (Floor beams.) The distribution in the two bottom flanges of the one floor beam investigated seemed good for static loads, and also for dynamic stresses except as indicated by stremmatograph No. 4 in runs 1868-93 and stremmatograph No. 12 in runs 1868-77, Table III. It does not seem justifiable to charge the floor beam with unequal distribution because during the same runs the West instruments, generally more dependable, indicated a high degree of uniformity.

Results—Distribution of stresses. (Hip verticals.) All the information is in agreement to the effect that the inside portions of the hangers are considerably more stressed than the outside and also that

the impact in hangers is uniformly high. In the hangers of this structure, however, no unit stresses were found high enough to cause concern. It is perhaps well that the usual practice prevails of using excess material in order that these members may have the same general dimensions as the intermediate posts.

Results—Distribution of stresses. (Truss members.) The tendency in the hangers for greater stress in the inside of the members is also apparent in all of the intermediate posts and the diagonals. It is less however in the diagonals than in the hangers and still less in the intermediate posts.

Results—Computed stresses. In Table XIII are given, for comparison, the computed stresses and unit stresses in the members and for the loads on which readings were taken.

Results—Strain gage checks. No systematic checks were attempted by use of the strain gage though a number of static readings were taken on the second stringer in the west panel, the floor beam at L1 and the hip vertical, U1-L1, on west end of north truss. No thorough comparison has yet been made of the results with those from the extensometers; and the strain gage notes are not incorporated in this preliminary bulletin. They are available, however, for any further study which may be made. Sufficient consideration has been given to them to make it apparent that they check, in a general way, the magnitude and the distribution of the static stresses obtained by the other instruments. These results have been of particular service already in locating the neutral axis of the stringers.

Bureau of Public Roads new photographic mirror extensometer. The season's work was planned with the expectation that the new photographic mirror extensometer designed and built by the Bureau of Public Roads would be available. However it did not arrive on the ground until the active field work was closed. E. B. Smith, senior testing engineer for the Bureau, who had a large part in the development of the instrument, kindly consented to bring it for comparison with the instruments used during the season and reached Ames on September 18. It was used in comparison with all of the other instruments on the bridge and for laboratory calibrations September 18, 19 and 21.

One of the most interesting parts of the laboratory work was a comparison, on the flanges of a 12-inch—31.5-pound I-beam in flexure, of the new instrument with the Turneaure, two Wests, a stremmatograph, two Morris "max" compression instruments and a "max" instrument brought out by Mr. Smith. These are shown in Fig. 5. Fig. 7 shows the photographic instrument, the Turneaure and two West's on the west hip vertical of the south truss of the Skunk River bridge. The readings show a close comparison of the photographic and West instruments on the northwest flange and of the Turneaure and a West on the northeast flange but a decided difference in impact between

the two flanges when obstructions were used. It seems probable that the obstructions were so placed that the blows of the truck wheels were applied slightly to the east of the center of the floor beam (the far side) and that the effect of these blows was greater on that side of the hanger. These conclusions are based upon five runs over a 1-inch block and five over a 2x4-inch plank, which are reasonably consistent. Four runs on clean floor indicate, rather consistently, an impact just below 20 per cent, while, for the obstructions less than 75 per cent is indicated for the northwest flange and over 100 per cent for the northeast one.

Possibilities for future work. It is no less evident now than when the season's work was started (and perhaps no more so) that the problem would not be completed in 1922, in fact, that it would be just nicely begun. Assuming that the problem should be followed up in a truly scientific manner and laws or even empirical formula deduced the work would naturally include:

A. Investigations for:
1. Other span lengths.
2. Other types of structures.
3. Other floor surfaces.
4. Other loads with various tires.

B. Certain studies to be made upon this and other structures such as:
1. The effect of speed.
2. The effect of tractor treads.
3. The effect of the condition of solid tires.
4. The effect of sudden starting and stopping.
5. Stress distribution to be checked against computed secondary stresses.
6. The relation between the intensity of a blow such as may be struck by a truck wheel and the resulting stresses in a structure. This may make it possible to take advantage of any work, such as that recently done by the United States Bureau of Public Roads, which gives a quantitative measure of the impact of a vehicle. (The present work shows that high stresses, and perhaps the highest ones in stringers, floor beams, and hip verticals result from a single blow of a rapidly moving truck passing over an obstacle.)
7. The relation between impact and the roughness of floor pavement. (Profiles showing roughness of floor of Skunk River bridge were taken by the Engineering Experiment Station force after the close of the season's work. No detailed examination has yet been made of the profiles but it has been noted that the roughness was more pronounced over the first floor beam on the profile 1 foot from south

curb than at 2 feet. It seems possible therefore that that is one reason why greater impact was observed in the runs where the outside wheels were 1 foot from the curb than when the distance was 2 feet.)

Instruments for future work. Every instrument used during the season has contributed to the value of the work. It has been pointed out, however that there was considerable variation in the consistency of results and in the time consumed in taking and in working them up.

The season's work has brought out the desirability of two distinct types—direct reading and self recording. A recording instrument has naturally the greatest value as it gives a graphic picture of stress variations during the passage of a load. Direct readings are almost indispensable in giving instant indications of the intensity of stresses, thus, making it possible to "feel the way" and avoid conditions of overstress and to serve as a check upon the graphic record. The possibilities of the personal factor in making occasional faulty set-ups, of instruments getting out of adjustment, of neglect to make the proper indentification of any particular reading and other causes are so great that occasional if not constant, checks should be made by different instruments.

For a recording instrument the photographic mirror extensometer of the Bureau of Public Roads appears to be the most satisfactory and it seems desirable that they be constructed in sufficient quantity so that a number of them may be available for the coming season. For direct readings, the West has given the most consistent results for static loads and low impacts. Recent trials indicate that by choking the dials high impacts as well may be accurately observed.

No one instrument combines the factors of approximate immediate results, positive identification, quick computations and permanent record as the Turneaure. It seems that the gage length is too long and the force necessary to put the instrument in action is too great to give results as high in precision as the ones just mentioned. Yet, it is an instrument which should be welcomed upon any impact investigation.

The Morris "max" instrument while slower in action and less precise in results would be of special value when large impacts were under observation and the other instruments were not yielding consistent results.

The stremmatograph, while perhaps the most cumbersome in use, and the less precise for small stresses, might be even the best available for certain high stresses under severe impact conditions. The combinations of the stremmatograph and the West, as mentioned on page 13 might well be considered in this connection.

Strain gage readings for distribution of stress under static loads will always add a finish to any extended series of stress measurements.

Number of instruments. It would be very nice, in work of this nature, to have at least eight instruments on each of the thirty odd

members of each truss and at least two on each of the eighty-one stringers and floor beams with a few defectometers and other special instruments thrown in for good measure. Then assuming them all to work perfectly all the time, with a few applications of each of a few different loads, a very interesting and rather complete story would be told of the elastic behavior of the structure.

This is manifestly impossible. Four instruments, one for each of the four flanges of the ordinary member seems to be the minimum number which would be at all efficient; and with four the efficiency would be low. It would seem desirable that no party be sent out with less than eight of which four or more be of a recording type.

TABLE I.—STRINGER 2 FEET NORTH OF SOUTH CURB

(10 in. 25 lb. I-beam)

Load—Truck A, headed west, moving, south wheel 1 ft. from south curb.
Truck B, headed east, at rest, north wheel 2 ft. from north curb.

Instruments—All on center line of stringer span.

Gage of Instruments—West 20 in. Turneaure 48 in.

Run	Speed	Obstruction	North Flange				South Flange	
			Turneaure		West No. 1		West No. 2	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.
1580	0		11,300		9,300		9,600	
1582	0		10,700		9,300		9,300	
1584	0		10,800		9,300		9,400	
1586	0		11,000		9,300		9,600	
Average	static		11,000		9,300		9,500	
1579	12.8	None	12,300				10,200	
1581	10.7		12,500				9,900	
1580	10.7		11,600		9,300			
1585	9.1		12,800		9,800		10,200	
1587	9.8		12,500		9,700		9,900	
Average	10.6		12,300	12	9,600	3	10,100	6
Av. two highest			12,700	16	9,800	5	10,200	7
1590	11.7	1" x 2"	15,300				11,600	
1591	16,0	south	15,300		13,100		14,500	
1592	10.7	wheel	14,700					
1593	12.8	Truck A	14,700				13,100	
Average	12.8		15,000	36	13,100	33	13,100	38
Av. two highest			15,300	39			13,800	45
1598	9.1	2" x 4"	19,500					
1599	9.8	south	21,500					
1600	10.7	wheel	23,600		Impossible	to read de	finitely	
1601	11.7	Truck A	23,100					
1602	9.1		22,000					
Average	10.0		21,900	100				
Av. two highest			23,400	112				

TABLE II.—STRINGER 2 FEET NORTH OF SOUTH CURB

(10 in. 25 lb. I-beam)

Load—Truck A, south wheel 1 ft. from south curb.
Truck B, north wheel 2 ft. from north curb.

Both trucks headed west, moving parallel

Gage of Instruments—West 20 in. Turneaure 48 in.
Instruments—Center line of span.

Run	Speed	Obstruction	North Flange				South Flange	
			Turneaure		West No. 1		West No. 2	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.
	0		11,200		10,300		9,900	
1620	0		10,800		10,100		9,900	
1621	0		11,200		10,400		9,900	
1622	0		10,600		10,400		9,600	
1623	0		11,700		10,400		10,000	
Average	static		11,100		10,300		9,900	
1624	9.1	None	13,200		11,800		10,200	
1630	10.7		11,600		11,300		9,900	
1632	12.8		11,900		10,500			
1633	10.7		12,800		11,700			
1635	12.8		12,300				10,400	
Average	11.2		12,400	11	11,300	10	10,200	3
Av. two	highest		13,000	16	11,800	14	10,300	4
1645	14.2	1" x 2" north wheel Truck A	19,000		Impossible to read definitely			
1646	10.7		16,000					
1647	12.8		11,900					
1648	12.8		18,300					
1649	11.7		18,300					
1650	9.8		17,100					
1651	9.8		17,800					
1652	14.2		17,200					
Average	12.0		17,000	53				
Av. two	highest		18,700	67				
1653	6.4	2" x 4" south wheel Truck A	16,400		14,800		11,600	
1654	6.1		16,900		14,800		12,700	
1655	9.8		21,600					
1656	9.8		16,800				11,700	
Average	8.0		17,900	60	14,800	43	12,000	22
Av. two	highest		19,200	72	14,800	43	12,200	24

TABLE III.—FLOOR BEAM AT L1

(24 in. 80 lb. I-beam)

Load—Trucks A and B headed west—parallel.
Truck A, south wheel 2 ft. from south curb.
Truck B, north wheel 2 ft. from north curb.

Instruments—All 1.5 ft. south of center line.
Gage of Instruments—All 20 in.

Run	Speed	Obstruction	East Flange				West Flange			
			West No. 1		Strem. No. 4		West No. 2		Strem. No. 12	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.	Stress	% Imp.
1864	0		6,500		6,500		6,700			
1865	0		6,500		7,400		6,200			
1866	0		6,700		6,700		6,400			
1867	0		6,500		6,800		6,400			
Average	static		6,600		6,900		6,400		(6,600)	
1868			7,300		8,300					
1869	9.8		7,400		11,600		7,300		7,500	
1870	10.6		7,500		11,600		7,500		7,000	
1871	12.8		7,200		9,500		7,300			
1872	9.8	None	7,200		10,000		7,100		12.500	
1873	12.8		7,100		11,600		7,000		10,000	
1874	11.6		7.200		11,600		7,300		8,300	
1875	9.8		7,000		11,200		7,100			
1876	12.8		7,400		10,800		7,400			
1877	9.8		7,200				7,400			
Average	11.1		7,200	10	10,700	55	7,300	13	9,000	36
Av. two	highest		7,500	14	11,600	67	7,500	17	11,300	72
1886	10.6		9,400		13,700		8,800		8,300	
1887	12.8	North	9,900		13,300		9,100			
1888	12.8	wheel	8,700		10,800		8,700		9,100	
1889	9.8	Truck	7,000		10,800		8,700		8,300	
1890	8.5	A			11,600		7,300			
1891	10.6	over	9,000		13,300		8,800		10,000	
1892	9.8	1″	8,700		14,500		8,000		10,400	
1893	12.8		8,700		14,100		8,000		7,500	
Average	10.9		8,800	33	12,800	85	8,400	31	8,900	35
Av. two	highest		9,700	46	14,300	106	9.000	40	10,200	55
1899	7.9	North	8,600		10,000		9,100		10,000	
1900	7.1	wheel	9,000		8,300		8,700		8,700	
1901	7.5	Truck	8,600				8,800			
1902	7.1	A	7,100		8,100		7,700		7,900	
1903	7.5	over 2″ x 4″	7,000		7,100		7,300		9,100	
Average	7.4		8,100	23	8,400	22	8,300	30	8,900	35
Av. two	highest		8,800	33	9,200	33	9,000	40	9,600	45
1904	7.5	Both	8,700		8,300		9,000		10,600	
1905	6.4	wheels	8,600		8,500		9,400		8,300	
1906	5.8	of A	8,600		10,000		9,100		11,500	
1907	6.7	over	8.400		8,500		9,400			
1908	6.4	2″ x 4″	9,100		10,000		10,200		9,300	
Average	6.5		8,700	32	9,100	32	9,400	47	10,000	52
Av. two	highest		8,900	35	10,000	45	9,800	53	11,100	68

TABLE IV.—HIP VERTICAL U1 L1 SOUTH TRUSS WEST END

(2 channels—8 in. x 11.5 lb.)

Load—Truck A, headed west, south wheel 2 ft. from south curb.
Truck B, headed west, north wheel 2 ft. from north curb.

Instruments—Turneaure lower point 7.50 ft. above L1.
West No. 3 lower point 8.75 ft. above L1.
West No. 4 lower point 8.75 ft. above L1.

Gage of Instruments—West 20 in. Turneaure 53 in.

Run	Speed	Obstruction	N. W. Flange				S. W. Flange	
			Turneaure		West No. 4		West No. 3	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.
1864	0		4,500		4,400		2,800	
1865	0		4,400		4,400		2,500	
1866	0		4,500		4,500		2,600	
1867	0		4,400		4,400		2,300	
Average	static		4,500		4,400		2,600	
1868	8.5		5,200		4,400		2,900	
1869	9.8		4,900		4,900			
1870	10.6		5,400		4,500		2,900	
1871	12.8		5,100		4,900		2,800	
1872	9.8	None	4,600		4,800			
1873	12.8		4,600		5,200		2,800	
1874	11.6		4,800		4,500		2,900	
1875	9.8		4,600		4,800			
1876	12.8		4,600		5,100		2,600	
1877	9.8		4,700		4,600			
Average	10.8		4,900	10	4,800	9	2,800	8
Av. two	highest		5,300	19	5,200	18	2,900	11
1878	12.8		8,400					
1879	9.8		7,900					
1880	9.8	1″ x 2″	8,900					
1881	11.6	south	9,900		Impossible to read definitely			
1882	11.6	wheel	7,700					
1883	9.8	Truck A	6,700					
1884	10.6		7,600					
1885	9.8		8,600					
Average	10.7		8,200	85				
Av. two	highest		9,400	110				
1894	11.6	2″ x 4″	11,600					
1895	11.6	south	9,200					
1896	9.8	wheel	6,500		Impossible to read definitely			
1897	9.1	Truck A	7,800					
1898	11.6		12,400					
Average	10.7		9,500	114				

TABLE V.—DIAGONAL L5 U6 NORTH TRUSS EAST END

(2 angles 3½ x 3 x 5-16 in.)

Load—C, B, A train 2 ft. south of north curb headed west.

Instruments—West No. 2 and No. 3 lower point 12.5 ft. above L5.
West No. 4 " " 15.5 ft. above L5.
Turneaure " " 11.5 ft. above L5.

Gage of Instruments—West 20 in. Turneaure 48 in.

NOTE: All figures not preceded by a minus (—) sign are plus (tension).

Run	Speed	Obstruction	North Angle				South Angle			
			West No. 3		West No. 4		West No. 2		Turneaure	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.	Stress	% Imp.
2198	0		4,400		4,600		4,800		5,200	
2199	0		4,900		4,800		5,400		5,200	
2200	0		4,900		4,600		5,400		5,200	
2201	0		4,500		4,500		5,400		5,300	
Average	tension	static	4,700		4,600		5,300		5,200	
2210	0		—2,300		—2,300		—2,200			
2211	0		—2,300		—2,300		—2,200			
2212	0		—2,300		—2,300		—1,800			
2213	0		—2,300		—2,300		—1,900		—1,000	
2214	0		—2,200		—2,300		—2,000		—1,000	
2215	0		—2,300		—2,300		—2,000		—1,000	
Average	comp.	static	—2,300		—2,300		—2,000		—1,000	
2202	5.0	None	5,200		6,500		5,800		6,500	
2203	5.0		5,500		7,000		5,700		6,700	
2204	5.0		5,500		6,100		5,800		6,600	
2205	5.0		6,400		6,400		5,800		6,800	
2206	5.0		4,800		6,200		6,100		7,000	
2207	5.0		—4,100		—4,200		—2,900			
2207	5.0		4,800		6,100		5,800		6,200	
2208	5.0		—3,500		—4,200		—2,500			
2208	5.0		4,900		6,100		5,500		6,400	
2209	5.0		—2,800		—3,900		—2,900			
2209	5.0		5,500		6,100		5,800			
Average	tension		5,200	11	6,300	37	5,800	10	6,600	27
2217	5.0	All wheels over 2″ x 4″ at L5			6,500		—2,600			
			6,000		—4,100		6,100		6,600	
2218	5.0				7,000		—2,900			
			6,000		—3,800		6,200		7,800	
2219	5.0				7,100		—2,600			
			6,200		—4,200		5,800		6,800	
2220	5.0				6,500					
			5,500		—3,600				7,400	
2221	5.0				6,200					
			6,100		—4,100		7,300		7,200	
Average	tension		6,000	28	6,700	46	6,300	19	7,200	38
2222	5.0	All wheels over 2″ x 4″ at L6			5,800				—1,700	
			—4,600		—5,100				—6,200	
2223	5.0				5,500				—2,600	
			—4,400		—5,100				6,800	
2224	5.0				5,800				—2,000	
			—4,900		—5,700				6,700	
2225	3.0						—2,900		—1,600	
			—6,200		—5,800		5,800		6,500	
2226	3.0				5,500		—2,900		—1,600	
			—5,100		—4,800		5,800		6,500	
2227	4.0				5,100		—2,600		—1,100	
			—5,100		—4,400		5,800		6,300	
Average	tension				5,500	20	5,800	10	6,600	27

TABLE VI.—POST U6 L6 NORTH TRUSS EAST END

(2 channels 8 in. 11.5 lb.)

Load—Train C, B, A, headed west 2 ft. from north curb.
Instruments—West, lower point 9 ft. above L6.
Turneaure, lower point 8 ft. above L6.
Gage of Instruments—West 20 in. Turneaure 48 in.

NOTE: All figures not preceded by a minus (—) sign are plus (tension).

Run	Speed	Obstruction	N. E. Flange		S. E. Flange				S. W. Flange		N. W. Flange	
			West No. 1		West No. 2		Turneaure		West No. 3		West No. 4	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.	Stress	% Imp.	Stress	% Imp
2166	0		—2,600		—2,300		—2,800		—2,300		—1,700	
2168	0		—2,800		—2,800		—2,900		—1,900		—1,900	
2169	0		—2,600		—2,800		—2,700		—1,900		—1,900	
2175	0		—2,300		—2,800		—2,700		—1,900		—2,000	
2176	0		—1,900		—2,300		—2,700		—1,600		—1,700	
2177	0		—2,600		—2,600		—2,800		—1,900		—1,700	
2178	0		—2,000		—2,500		—2,700		—1,700		—1,600	
Av.	comp.	sta.	—2,300		—2,600		—2,800		—1,900		—1,800	
2179	0		1,500		2,200		2,400		1,000		2,200	
2180	0				2,200		2,700		1,200		2,300	
2181	0		400		2,200		2,600		1,200		2,200	
2182	0		600		2,200		2,800		1,200		2,300	
Av.	tens.	sta.	800		2,200		2,600		1,200		2,200	
2170	5.0	None			7,500		3,400				3,600	
			—3,300		—3,800		—3,100		—2,500		—2,300	
2171	5.0		2,900		7,300		3,400		2,900		4,300	
			—3,300		—3,600				—2,300			
2172	5.0		2,300		8,700		3,400		3,000		4,100	
			—3,200		—3,600		—2,900		—2,000			
2173	5.0		2,800		1,300		3,000		2,600		5,100	
			—3,500	None	—3,300		—2,900		—2,200		—2,500	
2174	5.0		3,000		9,400		3,100		2,900		6,500	
			—3,200		—4,100				—2,200		—2,500	
2183	5.0		1,000		5,800		3,300		1,500		4,400	
			—2,800		—2,900				—2,000			
2184	5.0		900		7,300		3,600		2,500		4,100	
			—2,600		—2,600				—2,000			
2185	5.0		1,000		5,100		4,300		2,300		4,100	
			—2,800		—2.900				—1,900			
Av.	comp.		—3,100	35	—3,400	30	—3,000	7	—2,100	10	—2,400	33
2186	5.0	All wheels over 2" x 4"	1,000		7,300		3,700		2,200		4,500	
			—2,800		—2,900		—2,900		—2,200		—2,600	
2187	5.0		900		7,300		3,300		2,900		4,400	
			—3,000		—2,900				—2,600		—2,600	
2188	5.0		900		7,300		3,100		3,000		4,200	
			—3,000		—2,900		—3,100		—2,000		—2,800	
2189	5.0		900		8,000		3,300		3,900		4,600	
			—2,900		—2,900		—3,000		—2,000		—2,800	
2190	5.0		700		5,800		3,800		3,600		4,200	
			—2,600		—2,900		—2,900		—2,000		—2,000	
Av.	comp.	(—)	—4,300	87	—2,900	11	—3,000	7	—2,200	16	—2,600	45
2191	5.0	All wheels over 2" x 4" at L6			8,000		6,800		5,800		7,200	
			—2,800						—2,200		—2,200	
2192	5.0				7,300		3,800		4,500		6,500	
			—2,800		—2,900		—2,900		—2,000		—2,200	
2193	5.0				5,800		4,500		4,200		6,500	
			—2.600				—2,900				—2,200	
2194	5.0				7,300		4,800		4,800		5,800	
											—2,200	
2195	5.0				8,000		6,800		6,500		7,300	
					—2,800				—2,000		—2,200	
2196	5.0				6,500		3,900		4,100		6,100	
											—2,000	
2197	5.0				7,700		5,200		4,600		7,400	
					—2,800				—2,200		—2.200	
Av.	comp.	(—)	—2,700	18	—2,800	8	—2,900	4	—2,100	10	—2.200	23

TABLE VII.—WEST APPROACH SPAN. STRINGER 2 FT. NORTH OF SOUTH CURB.

(15 in. 80 lb. I-beam)

Load—Truck A headed west 1 ft. from south curb.

Instruments—All on center line of span.

Gage of Instruments—West 20 in. Turneaure 48 in.

Run	Speed	Obstruction	North Flange				South Flange	
			Turneaure		West No. 4		West No. 3	
			Stress	% Imp.	Stress	% Imp.	Stress	% Imp.
2011	0		5,200		5,300		5,100	
2012	0		5,200		5,500		5,100	
2013	0		5,100		5,500		5,100	
Average	static		5,200		5,400		5,100	
2014	11.9	None	6,200		6,700		7,300	
2015	11.9		6,200		6,700		6,400	
2016	10.8		6,200		6,500		6,100	
2017	11.9		6,300		6,700		6,400	
2018	11.9		6,000		6,700		5,900	
2019	12.5		6,000		6,700		5,900	
2020	11.4		6,500		7,000		6,500	
2021	10.8		6,500		6,700		6,400	
2022	11.9		6,300		7,000		5,900	
2023	10.8		6,200		6,700		5,800	
2024	10.4		6,500		6,700		6,200	
2025	11.9		6,600		6,500		5,900	
Average	11.4		6,300	21	6,700	24	6,200	22
Av. two	highest		6,600	27	7,000	30	6,900	35
2026	13.3	1″ x 2″ south wheel Truck A	7,000		6,800		8,400	
2027	10.8		8,000		7,200		8,700	
2028	10.4		7,100		8,000		6,400	
2029	10.4		6,800		7,200		7,400	
2030	11.4		7,100		7,700		7,700	
2031	11.4		7,800		8,000		8,700	
2032	10.8		7,000		7,800		8,000	
2033	10.4		7,200		7,800		7,800	
2034	10.4		7,100		7,500		8,400	
2035	10.4		7,000		8,000		8,100	
2036	11.9		7,400		8,000		6,500	
2037	11.4		7,100		7,800		8,600	
2038	11.9		7,500		8,300		8,000	
2039	10.4		7,100		6,700		7,000	
Average	11.0		7,200	39	7,600	41	7,300	43
Av. two	highest		7,900	52	8,200	53	8,700	70
2052	5.6	2″ x 4″ south wheel Truck A	8,000		8,300		8,400	
2053	5.6		7,500		8,500		7,700	
2054	6.3		7,300		8,200		7,500	
2055	5.7		7,500		7,500		7,500	
2056	6.5		7,100		7,500		7,000	
2057	6.3		7,500		8,000		7,500	
2058	6.3		7,800		8,700		8,400	
2059	7.2		7,200		8,300		7,500	
2060	6.8		7,500		8,700		7,700	
Average	6.2		7,500	44	8,200	52	7,700	51
Av. two	highest		7,900	52	8,700	61	8,400	65

TABLE VIII.—WEST APPROACH SPAN. STRINGER UNDER SOUTH CURB

(15 in. 80 lb. I-beam)

Load—Truck A, 1 ft. north of south curb headed west.

Instruments—Center line of span.

Gage of Instruments—All 20 in.

Run	Speed	Obstruction	North Flange			
			West No. 2		Strem. No. 12	
			Stress	% Imp.	Stress	% Imp.
2011	0		3,300		2,800	
2012	0		3,300		2,800	
2013	0		3,300		2,800	
Average static			3,300		2,800	
2014	11.9		4,600		3,500	
2015	11.9		4,200		3,100	
2016	10.8		4,100		3,200	
2017	11.9		3,900		3,200	
2018	11.9		4,100		3,500	
2019	12.5	None	4,100			
2020	13.0		4,500		3,200	
2021	10.8		4,400		3,300	
2022	11.9		4,500		3,400	
2023	10.8		4,200			
2024	10.4		4,600			
2025	11.9		4,500			
Average	11.6		4,300	30	3,300	18
Average two highest			4,600	39	3,500	25
2026	13.2		5,500		3,200	
2027	10.8	south	5,900		4,200	
2028	10.4	wheels	6,400			
2029	10.4	over	6,400			
2030	11.3	1″ x 4″	5,800			
2031	11.3	at Mid-	7,400			
2032	10.8	span	6,700			
2033	10.4		6,800			
Average	11.0		6,400	94	3,700	32
Average two highest			7,100	115		
2052	5.6		4,500			
2053	5.6	South	5,400			
2054	6.3	wheels	5,500		4,500	
2055	5.7	over	5,500			
2056	6.5	2″ x 4″	5,700			
2057	6.3	at Mid-	6,100			
2058	6.3	span	5,600			
2059	7.2		5,500			
2060	6.8		6,200			
Average	6.2		5,600	70	4,500	61
Average two highest			5,900	79		

TABLE IX.—PER CENT OF IMPACT IN STRINGERS

South Outside Stringer—0.5 Ft. North of South Curb

Runs	Speed	Obstr.	Trucks A and B			Truck A				Tractor C			
			West	Turn.	Prob.	West	Turn.	Strem.	Prob.	West	Turn.	Strem.	Prob.
1707-13	13.4	......	....	....	....	9	....	33	10	....	....	....	....
1717-24	13.4	1 in.	....	....	....	106	....	160	100	....	....	....	....
1725-8	6.9	2 in.	....	....	....	152	....	130	140	....	....	....	....
1787-94	......	......	....	....	....	....	....	....	....	72	....	170	?
1797-1822	......	......	....	....	....	....	....	....	....	....	....	112	?

Second Stringer—2 Ft. North of South Curb

Runs	Speed	Obstr.	Trucks A and B			Truck A				Tractor C			
			West	Turn.	Prob.	West	Turn.	Strem.	Prob.	West	Turn.	Strem.	Prob.
40-166	8.9	......	....	....	....	17	....	13	15	....	....	....	....
96-172	8.7	1 in.	....	....	....	38	....	28	30	....	....	....	....
1579-87	10.6	......	5	12	10	....	....	....	....	....	....	....	....
1590-3	12.8	1 in.	35	26	35	....	....	....	....	....	....	....	....
1598-1602	10.1	2 in.	( )	100	75	....	....	....	....	....	....	....	....
1624-35	11.2	......	7	11	10	....	....	....	....	....	....	....	....
1645-52	12.0	1 in.	( )	53	50	....	....	....	....	....	....	....	....
1653-6	8.0	2 in.	( )	60	50	....	....	....	....	....	....	....	....
1707-13	13.5	......	....	....	....	4	4	....	4	....	....	....	....
1717-24	13.3	1 in.	....	....	....	....	46	....	40	....	....	....	....
1725-8	6.9	2 in.	....	....	....	( )	38	....	40	....	....	....	....
1787-1801	5.0	......	....	....	....	....	....	....	....	200	18	....	?

TABLE X.—PER CENT OF IMPACT IN DIAGONALS AND VERTICAL POSTS

Diagonals

Number	Runs	Speed	Obstr.	Trucks A and B		Train C, B, and A		
				West	Turn.	West	Turn.	Prob.
U2 L3................	853-5	6.4	....	23	19	....	....	....
	860-2	6.8	2 in.	73	82	....	....	....
	874-5...	6.9	2 in.	90	150	....	....	....
U3 L4................	691-5	7.1	....	22	....	....	....	....
	698-700	8.9	1 in.	31	....	....	....	....
	712-15	4.7	2 in.	65	....	....	....	....
	708-11	6.8	2 in.	68	....	....	....	....
U6 L7................	2154-7	5.0	....	....	....	7	3	5
	2158-65	5.0	2 in.	....	....	15	12	15
L5 U6................	2202-9	5.0	....	....	....	20	27	20
	2217-21	5.0	2 in.—L5	....	....	30	38	30
	2222-7	5.0	2 in.—L6	....	....	15	27	....

Vertical Posts

Number	Runs	Speed	Obstr.	Trucks A and B		Train C, B, and A		
				West	Turn.	West	Turn.	Prob.
U2 L2................	917	7.5	....	20	....	....	....	....
	918-23	6.3	2 in.	50	....	....	....	....
	932-5	6.1	2 in.	70	....	....	....	....
U6 L6................	2170-85	5.0	....	....	....	30	7	25
	2186-90	5.0	2 in.—L5	....	....	40	7	30
	2191-7	5.0	2 in.—L6	....	....	15	4	....
U5 L5................	2234-8	5.0	....	....	....	42	20	30
	2239-43	5.0	2 in.—L4	....	....	110	30	60
	2244-8	5.0	2 in.—L5	....	....	65	10	....

TABLE XI.—PER CENT OF IMPACT—MISCELLANEOUS

Runs	Speed	Obstr.	Trucks A and B				Truck A				Tractor C			
			West	Turn.	Strem.	Prob.	West	Turn.	Strem.	Prob.	West	Turn.	Strem.	Prob.
Hip Verticals U1 L1														
1831-41	4.8	......	......	......	......	......	......	......	......	......	170	80	105	100
1868-77	10.8	......	9	10	......	10	......	......	......	......	......	......	......	......
1878-85	10.7	1 in.	170	85	......	100	......	......	......	......	......	......	......	......
1894-8	10.7	2 in.	180	114	......	125	......	......	......	......	......	......	......	......
Floor Beam AT L1														
1853-63	4.7	......	......	......	......	......	......	......	......	......	70	......	......	70
1868-77	11.1	......	12	......	45	15	......	......	......	......	......	......	......	......
1886-93	10.9	1 in.	32	......	60	35	......	......	......	......	......	......	......	......
1899-1903	7.4	2 in.	27	......	29	30	......	......	......	......	......	......	......	......
1904-8	6.5	2 in.	40	......	42	40	......	......	......	......	......	......	......	......
West Approach Span—South Outside Stringer														
2014-25	11.6	......	......	......	......	......	30	......	18	25	......	......	......	......
2026-33	11.0	1 in.	......	......	......	......	94	......	32	60	......	......	......	......
2052-60	6.2	2 in.	......	......	......	......	70	......	61	65	......	......	......	......
West Approach Span—Stringer 2 Ft. North of South Curb														
2014-25	11.4	......	......	......	......	......	23	21	......	20	......	......	......	......
2026-39	11.0	1 in.	......	......	......	......	42	39	......	40	......	......	......	......
2052-60	6.2	2 in.	......	......	......	......	52	44	......	50	......	......	......	......

TABLE XII.—SUMMARY OF IMPACT PERCENTAGES CONDENSED FROM TABLES IX, X AND XI.

Approach Span

Load	A		A-B		C-B-A		C
Condition of floor members	Clean	Obstr.	Clean	Obstr.	Clean	Obstr.	Clean
Stringers	25	50	....	....	....	....	....

Main Span

Load	A		A-B		C-B-A		C
Condition of floor members	Clean	Obstr.	Clean	Obstr.	Clean	Obstr.	Clean
Stringers	15	50	15	50	....	....	100
Floor beam	....	....	15	35	....	....	70
Hip vertical	....	....	10	100	....	....	100
Int. posts	....	....	....	....	30	60	....
Diagonals	....	....	20	75	20	30	....

TABLE XIII.—COMPUTED STRESSES AND UNIT STRESSES. STATIC LIVE LOADS.

Note.—Loads C-B-A are considered in series as a train. Loads A and B are considered parallel. No sign denotes tension. Minus sign denotes compression.

Member	Gross area	Stresses due to loads			Unit stresses		
		A	A & B	C, B, A	A	A & B	C, B, A
U1 L1	6.72	19,250	23,450	....	2,700	3,500	....
U2 L2	6.72	—7,370	—8,980	—14,500	1,100	1,340	2,060
U2 L2 Rev	6.72	10.6	12,900	11,000	1,570	1,920	1,640
U3 L3	6.72	—7.8	—9.5	—13,100	1,160	1,410	1,950
U3 L3 Rev	6.72	11.4	13.9	14,600	1,700	2,070	2,170
Lo U1	25.08	....	....	51,600	....	....	2,080
U1 L2	6.84	12,500	15,250	27,300	1,830	2,230	4,000
U2 L3	3.86	11,370	13,840	23,400	2,930	3,600	6,060
U2 L3 Rev	3.86	—9,400	—11,500	—9,800	3,260	4,000	3,400
U3 L4	2.88	11,560	14,050	21,300	4,020	4,880	7,400
U3 L4 Rev	2.88	—8,660	—10,540	—12,300	3,000	3,660	4,280
L3 U4	2.88	8,660	10,540	12,300	3,000	3,660	4,280
Floor beam—24in.—80lb. I-beam	....	....	1,627,000	....	....	9,350	....

Stringers—See Figs. 2, 3 and 4.